Return, Size, and Age of Steelhead at the Besadny Anadromous Fisheries Facility, 2003

Steve Hogler and Steve Surendonk

ABSTRACT

An annual steelhead assessment project was begun in 1992 at the Besadny Anadromous Fisheries Facility (BAFF) to (1) assess the return of the three steelhead strains to BAFF, and (2) collect basic biological information on each strain.

Spring operations in 2003 began on April 17, and continued until May 1. During this time period a total of 371 steelhead were handled (Table 1). The run consisted of 81 Chambers Creek strain steelhead (21.8% of the run), 68 Ganaraska (18.3%), 16 Skamania (4.3%), and 206 (55.5%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2003 was similar to the number handled in 2002 which was well below the 1996 to 2002 average steelhead run of 996 fish. The spring 2003 run was the second smallest run since 1996.

Chambers Creek strain steelhead ranged from 425 mm to 800 mm, with an average length of 617 mm. Weight ranged from 0.8 kg to 4.5 kg and averaged 2.2 kg. The average length and average weight for Chambers Creek steelhead in 2003 decreased from 2002 levels and were the lowest since 1996.

Ganaraska lengths ranged from 360 mm to 732 mm and averaged 556 mm. Weights ranged from 0.6 kg to 3.9 kg with an average of 1.83 kg. These were the smallest lengths and weights since 1996.

Skamania lengths ranged from 572 mm to 842 mm and averaged 741 mm. Weights ranged from 1.9 kg to 4.8 kg and averaged of 3.43 kg. Average length and weight slightly increased in 2003 from the 2002 level.

The summer/fall migration of steelhead was the worst on record without a single steelhead being captured at BAFF.

All strains of steelhead continue to exhibit decreasing returns to the weir. Of the spring running strains since 1993, Chambers Creek has returned in greatest number despite a sharp decline in number during the past three spring migrations. Survival based on return per thousand stocked also indicates Chambers Creek, in general, return at a higher rate than does Ganaraska strain steelhead although this trend may be reversing based on the return rates of the last four springs. Summer run Skamania have had reduced run numbers since the 1995 peak. The return rate of Skamania is the lowest of the three strains of steelhead.

INTRODUCTION

Wisconsin began its Lake Michigan rainbow/steelhead trout fishery in 1963 when rainbow trout were stocked in a Door County stream (Daly 1968). During the years following the original stocking, many changes in the fishery occurred including changes in the strains and age of fish stocked. Since 1988, Wisconsin has stocked three steelhead strains, Skamania, Chambers Creek, and Ganaraska for its Lake Michigan steelhead program. Although similar in appearance, each strain has unique characteristics that make each important to the overall steelhead program. We hoped that these strains would provide a good return to the creel and provide more fishing opportunities throughout the year for anglers in tributary streams.

To further enhance the steelhead fishery and continue the time series of biological information collected during earlier studies, an annual steelhead assessment project was initiated by Fisheries Management at the C.D. Besadny Anadromous Fishery Facility (BAFF) weir in 1992. The goals of this project are to (1) assess the return of the three steelhead strains to BAFF, (2) to collect basic biological information on each strain, and in past years (3) to floy tag adult fish to determine: handling mortalities from the spawning operation, angler return rate and movement of these fish in the Kewaunee River and in Lake Michigan. This report summarizes the data collected during the 2002 migratory runs of steelhead at BAFF.

METHODS

BAFF operations begin during early spring when ice on the Kewaunee River starts to break up and continues until ice up during early winter (Baumgartner 1995). Water is passed through the collection ponds and down the fish ladder, attracting migrating steelhead up the ladder and into the ponds. Ponds are sorted at least once a week and fish are passed upstream, spawned and passed, or held, depending on clip and ripeness. During spring migrations as fish proceed through the BAFF, the fish are checked for clips, sex and ripeness. Steelhead are measured to the nearest 1 mm and weighed to the nearest 0.01 kg. All fish receive a caudal fin clip to denote that data had been collected on that fish. Ripe fish with the appropriate strain fin clip are spawned, allowed to recover, and then passed upstream. Fish that are not ripe, but have the appropriate fin clip are returned to a holding pond. All other fish are measured, weighed, revived, and then passed upstream.

Late summer/early fall collection procedures differ from spring procedures because of warm water conditions, which may increase mortality of the handled steelhead. To maximize survival, fish are handled as little as possible. Steelhead are checked for fin clips, and sexed. Fish with target fin clips are sent to the Kettle Moraine Springs Fish Hatchery (KMSFH) and held until spawned. All other steelhead are passed upstream.

Annually data is analyzed using basic fishery statistics, such as average length and weight by sex and clip. A regression of length and weight for each strain is calculated. By using

standard weight and trophy weight, which is the measure of the weight of a 660 mm steelhead and the weight of the 95th percentile of steelhead respectively, we are able to track recent weight trends in the population. Handling mortality is estimated from the number of caudal fin clipped dead fish that are found in holding ponds, recovery tanks, and around the river release site. Catch numbers per day of weir operation are plotted to examine the timing of spring migratory runs.

RESULTS

Spring

Spring operations in 2003 began on April 17, and continued until May 1. During this time period a total of 371 steelhead were handled (Table 1). The run consisted of 81 Chambers Creek strain steelhead (21.8% of the run), 68 Ganaraska (18.3%), 16 Skamania (4.3%), and 206 (55.5%) unclipped, misclipped or strays from other streams or states. The total number of fish handled during the spring of 2003 was similar to the number handled in 2002 which was well below the 1996 to 2002 average steelhead run of 996 fish. The spring 2003 run was the second smallest run since 1996.

Chambers Creek strain

Chambers Creek strain steelhead were processed during each day of operation this spring (Table 2). The length of Chambers Creek steelhead ranged from 425 mm to 800 mm, with an average length of 617 mm (Table 1). Weight ranged from 0.8 kg to 4.5 kg and averaged 2.2 kg. The average length and average weight for Chambers Creek steelhead in 2003 decreased from 2002 levels and were the lowest since 1996.

Males comprised 67.9% of the run and averaged 602 mm in length and 1.97 kg in weight (Table 3). Two different Chambers Creek fin clips were observed for male fish, with the adipose-left maxillary (ALM) the most common. With the use of fin clips, returning fish can be assigned to age classes. Males returned at ages 2 and 3 (Table 4). Age 3 fish were the most common, and averaged 616 mm in length and 2.07 kg in weight. With 49 of the 55 returning males age 3, the 2003 run was essentially a run of a single age class of male fish.

Females comprised 32.1% of the run, averaged 651 mm in length and 2.71 kg in weight, and were represented by three different fin clips (Table 3). The most common clip was ALM with substantially fewer left maxillary (LM) and left maxillary-left ventral (LMLV) clipped fish captured Females returned at ages 3, 4 and 5 (Table 4). Age 3 females returned in the greatest number, and averaged 613 mm in length and 2.25 kg in weight.

Handling mortality was 0.0% for Chambers Creek during the spring run (Table 5). This was less than the handling mortality observed in 2002 and similar to the average handling mortality for Chambers Creek steelhead of 1.6% since 1996.

Ganaraska strain

Ganaraska were processed throughout spring operations (Table 2). Lengths ranged from 360 mm to 732 mm and averaged 556 mm. Weights ranged from 0.6 kg to 3.9 kg with an average of 1.83 kg (Table 1).

Males comprised 67.6% of the run, and had an average length of 531 mm and weight of 1.6 kg (Table 3). A total of two fin clips were observed for Ganaraska males, with the adipose, left ventral (ALV) clip the most common. Based on fin clip, ages 2, 3 and 5 returned during the spring migration (Table 4). Age 3 fish were the most common, with substantially fewer age 2 and age 5 fish captured. Age 3 males averaged 587 mm in length and 1.99 kg in weight.

Females comprised 32.4% of the run and averaged 605 mm in length and 2.29 kg in weight (Table 3). Two clips were detected for female Ganaraska, with the ALV clip the most common. The majority of returning females were age 3 and had an average length of 574 mm and average weight of 1.99 kg (Table 4). Substantially fewer age 5 female Ganaraska were captured.

Handling mortality was 0.0% for Ganaraska during the spring run (Table 5). This mortality rate was less than the seven year average of 0.8% for Ganaraska.

Skamania strain

Skamania were handled throughout the spring run in 2003 (Table 2). Lengths ranged from 572 mm to 842 mm and averaged 741 mm. Weights ranged from 1.9 kg to 4.8 kg and averaged 3.43 kg (Table 1).

Males comprised 37.5% of the run, and had an average length of 775 mm and weight of 3.71 kg (Table 3). A total of two different fin clips were observed for Skamania males, with the right maxillary clip (RM) the most common. Based on fin clip, ages 3 and 5 returned during the spring migration (Table 4). Age 5 fish were the most common and averaged 807 mm in length and 4.07 kg in weight.

Females comprised 62.5% of the run and averaged 720 mm in length and 3.71 kg in weight (Table 3). Two clips were observed on returning females that corresponded to ages 2, 4 and 5 (Table 4). The RM fin clip was the most common clip observed. Age 5 female Skamania averaged 752 mm in length and 3.57 kg in weight.

Handling mortality was 0.0% for Skamania for the seventh consecutive spring run (Table 5).

Non-broodstock steelhead

The final component of the spring run was those steelhead not used for broodstock collection. Although the majority of these fish were Chambers Creek, Ganaraska, or Skamania strain steelhead, they were unclipped, misclipped, or were study fish from another stream. Clipped or unclipped fish from other states were also part of this category. Members of this group were collected during each day of operation (Table 2), and were the largest single component of the spring run (Table 1).

Handling mortality for this group of steelhead was 0.0% which was slightly less than the seven year average of 0.9% (Table 5).

Summer/Fall

The 2003 summer/fall migration of steelhead was the lowest return on record without a single steelhead returning to BAFF (Table 2). BAFF was operated five days during October and November to process chinook and coho salmon.

DISCUSSION

Since 1992, we have been monitoring trends of several factors associated with the annual steelhead spawning migrations up the Kewaunee River to BAFF. They include abundance and run timing for each strain, length and weight, return rate, and handling mortality.

Timing and Abundance of the Run

Spring

The past five springs, 1998 through 2002, steelhead runs at BAFF have been markedly different in timing and abundance as compared to previous years (Hogler and Surendonk 1997, 1998, 1999, 2000, 2001, 2002 and 2003). Spring migratory runs before 1997 had been predictable with large numbers of Chambers Creek returning to the weir with the onset of operations and then slowly declining in number through the end of April. As the Chambers Creek run dwindled in number, Ganaraska numbers increased rapidly, peaked in mid-April, and declined through early May. However, since 1998, water level and flow have been very low during normal migration times. Instead of the typical pulses of steelhead, the fish that have returned, move in for a short period of time and then leave the Kewaunee River.

The decreasing trend in run abundance observed since 1992 has continued. The total number of steelhead handled at BAFF during the 2003 spring run was similar to what was seen in 2002 but is well below the peak run of 1996 and below the seven year average run size of 996. This year's run total was just 37.2% of the 1996 run (Figure 1).

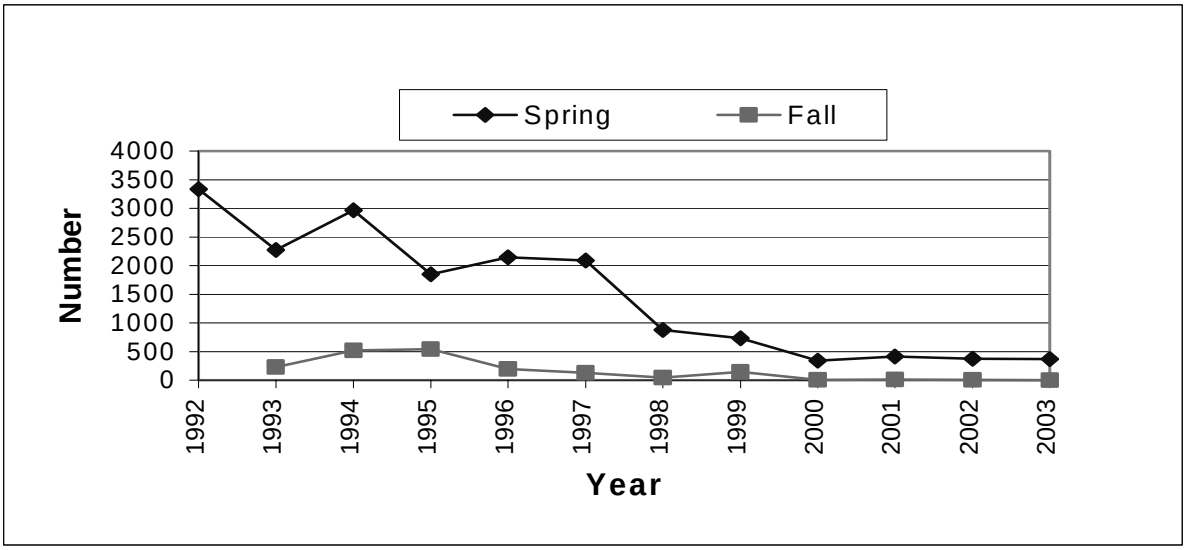


Figure 1. Steelhead return to BAFF during spring and fall runs, 1992-2003.

Possible reasons for the decrease in run abundance over time may include (1) reduction in stocking numbers resulting in fewer fish returning, (2) unusual weather conditions that have caused low lake levels or low flow making upstream migrations difficult, (3) increased mortality of stocked smolts (4) increased harvest or mortality of adult fish or (5) a combination of the previous reasons.

Stocking number continues to remain relatively stable for Chambers Creek and Ganaraska, although Skamania numbers have varied from year to year (Figure 2). Since 1992, the WDNR has stocked at least 30,000 steelhead of each strain into the Kewaunee River. Stocking number does not appear to be a cause for the decline in return number of steelhead in the Kewaunee River.

Unfavorable weather may explain some of the decline observed the past three springs. Early ice-out and quickly dropping flows may have caused steelhead to attempt to spawn in lower sections of the Kewaunee River or drop back into Lake Michigan and reabsorb their eggs instead of continuing to migrate upstream. In 2003 spring flows appeared to be adequate to draw steelhead into the river, but low Lake Michigan water levels caused several reaches of the river to be extremely shallow making upstream passage difficult for large fish. The number of younger, smaller fish observed this spring and the lack of larger, older fish appeared to support low water level as a partial reason for declining returns.

Mortality of smolts may also play an important role in the low return number seen the past three springs. Low flow in the Kewaunee River after stocking smolts above BAFF may have trapped fish in the upper river increasing smolt mortality and ultimately reducing the number of adults returning to the river. Very low flows over the past several years have

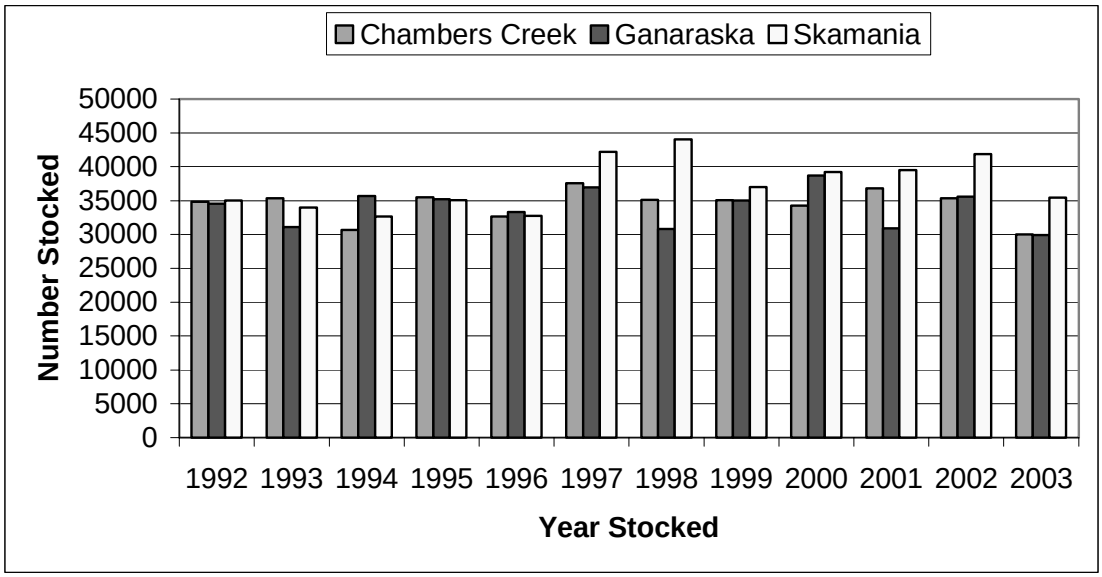


Figure 2. Stocking number by strain for steelhead stocked into the Kewaunee River from 1992 through 2003.

resulted in smolts being stocked below BAFF. It was hoped that the increased number of Age 4 fish that had returned the past several springs may be an indication of the benefits of lower river stocking. However, in 2003 the change in stocking location did not increase the number of steelhead returning to BAFF. Size at stocking has been shown to be an important factor in the survival of smolts and their ultimate contribution to the fishery (Seelbach 1985). Smolts stocked in 2003 (Chambers Creek-148 mm, Ganaraska-142 mm and Skamania-150 mm) were similar in length to smolts stocked in previous years, but slightly smaller in length then the 200 mm recommended by Seelbach (1985). In addition to physical size, condition factors, such as disease status or fat reserves, and predation on recently stocked steelhead may influence the number of smolts that survive and return as adults. These factors have not been researched for Kewaunee River steelhead making their impact on return number unknown.

Lakewide angler harvest of adult fish may also affect the number of returning spawners to BAFF. The annual steelhead harvest since the early 1990's has averaged just over 92,800 fish (Kubisiak 2003). Harvest during 1994, 1995 and 1998 exceeded 110,000 steelhead which likely reduced the number of steelhead able to return to BAFF. However, the average yearly harvest of steelhead since 2000 has declined to 72,900 which is 20% below the ten-year average harvest. The reduction in harvest of steelhead from the Wisconsin waters of Lake Michigan has not increased the number of steelhead returning to BAFF. However, results from our tagging studies (Hogler and Surendonk 1997 and 1998) indicate that steelhead have lakewide movement patterns. Reductions in harvest from one jurisdiction may be balanced by increased harvest from anglers by other states, resulting in no net increase in survival of Wisconsin steelhead.

Fall

The number of steelhead handled at BAFF (0) in the summer/fall of 2003 was substantially lower than the 540 fish captured in 1995 and indicates a near complete collapse of this component of the steelhead fishery in the Kewaunee River (Figure 1). Low flow, despite late spring and summer rainfall and low lake water level have severely limited the run. However, other factors such as stocking concerns and lake harvest must have also impacted the return of these steelhead.

Strain Performance

Chambers Creek

Average length and weight of Chambers Creek steelhead declined in 2003 from 2002 levels (Table 1). The decrease may be an artifact due to the small number of fish returning or that most of the returning fish were age 3 in 2003 rather than the age 4 fish that returned in 2002. Average, standard and trophy weight indices in 2003 all declined from 2002 levels (Figure 3). However, since 1993, the three weight trend indices have varied little for Chambers Creek steelhead.

Return rates from an individual year of stocking can also be evaluated by the use of fin clips. Since the majority of Chambers Creek fish traditionally return at age 4, we would expect to see the highest return rate of a year class occur three years after fish were stocked. In 2003, 4-year-old Chambers Creek steelhead stocked in 2000 returned at a much lower rate than 4-year-old fish stocked in 1995 (Table 7). Overall, 1998 and 2000 year classes of Chambers Creek steelhead have returned very poorly.

Ganaraska

Ganaraska strain steelhead have had more variation in yearly average length and weight than Chambers Creek strain fish (Table 1). All three weight indices declined in 2003 from 2002 levels and are the lowest of the past seven years (Figure 3). Long-term trends for each of the three weight indices however indicate that Ganaraska weights have been relatively stable since 1993.

The return rate of Ganaraska strain steelhead, which declined for fish stocked in 1995 through 1998, increased for 1999 stocked fish but sharply declined for 2000 stocked fish (Table 8). Similar to the Chambers Creek strain, Ganaraska stocked in 1998 and 2000 have performed poorly, with improvements in return noted for those steelhead stocked in 1999. Overall, return rate indicates that fish stocked in 1996 returned at a higher rate than those stocked in later years.

Skamania

Skamania had been a small, but consistent portion of the spring run until 2001 when their abundance dropped substantially. Average length and weight increased in 2003 from 2002 levels, but should be viewed cautiously because of the small sample size. Standard weight and trophy weights for 2003 were similar to those in 2002 (Table 1). However since this strain normally migrates upriver in late summer and fall, return rates during the spring are expected to be low (Table 9).

The number of Skamania collected during the fall run has varied greatly. High lake harvest and poor river conditions may be responsible for the variation in run number and run timing.

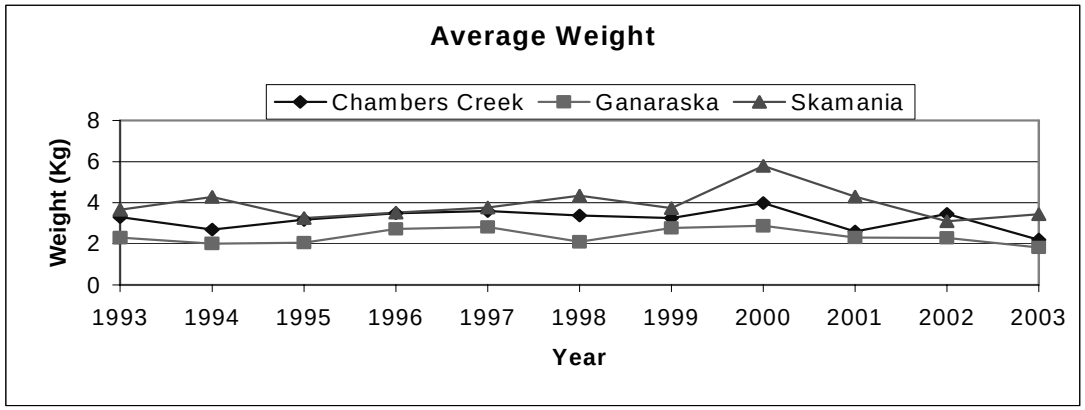
Comparison of Strain Preformance

All strains of steelhead continue to exhibit decreasing return to the weir. Of the spring running strains since 1993, Chambers Creek has returned in greatest number despite a sharp decline in number during the past three spring migrations. Survival based on return per thousand stocked also indicates Chambers Creek, in general, return at a higher rate than does Ganaraska strain steelhead although this trend may be reversing, based on the return rates of the last four springs. Summer-run Skamania have had reduced run numbers since the 1995 peak. The return rate of Skamania is the lowest of the three strains of steelhead and may be the result of longer lake exposure to angler harvest or from poorer river conditions encountered during fall migrations.

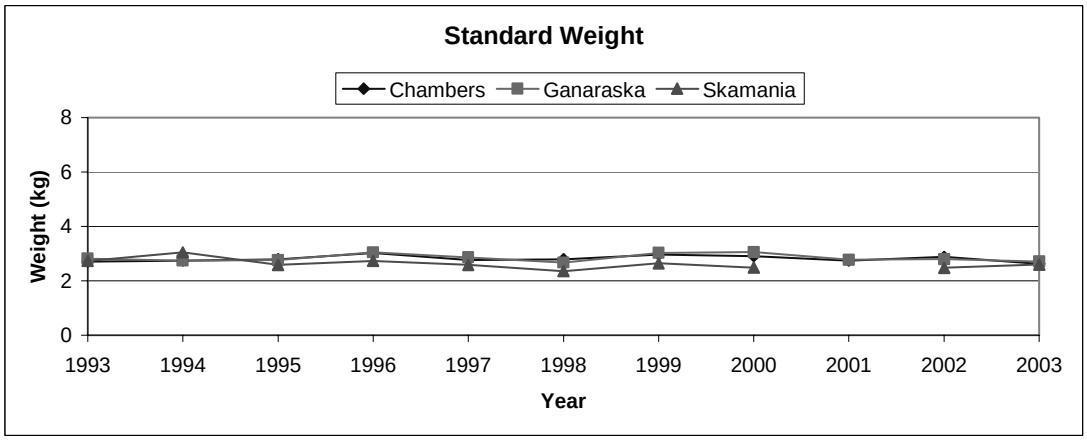
The exact reason(s) for these substantially lower return rates are unknown. Certainly low water has hurt return number but can't explain the entire decline in run number. Other potential reasons for the decline include poor imprinting to the river by smolts, predation on newly stocked steelhead by birds and other fish, entrapment behind the dam at BAFF under low flow conditions, poor river water quality, high harvest on adult fish by anglers on Lake Michigan and unhealthy fish from the hatchery. If returns continue to decline, each of these potential reasons must be examined to determine the cause of the decline.

Skamania continue to be the largest steelhead followed by Chambers Creek and Ganaraska. Mixed results from the three weight trends may indicate forage problems on Lake Michigan or that younger (smaller) fish are more common during spawning runs because of the reduced return rate for fish stocked in 1995-1998. However, decreasing return number may influence the trends of each weight index if smaller fish (younger in age) continue to dominate the run.

A



B



C

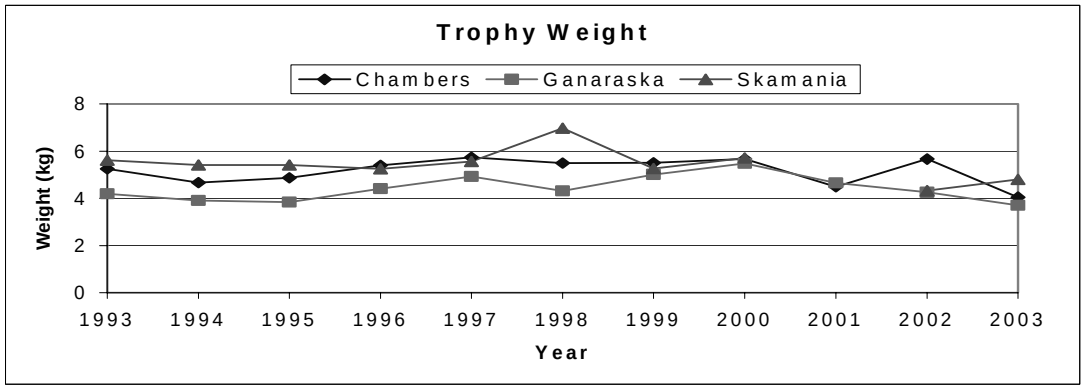


Figure 3. Weights trends for steelhead during spring migrations at BAFF, 1992-2003: (A) Average weight for each strain for that year, (B) Standard weight is based on the projected weight of a 660 mm steelhead, (C) Trophy weight for each strain based on the 95th. Percentile of weighed steelhead.

Handling Mortality

Handling mortality was 0.0% during the spring 2003 run (Table 5). Handling mortality, in number and percentage, has declined from 1996 levels despite river conditions that generally result in fish entering BAFF in poorer condition.

SUMMARY

The 2003 spring run total was the second poorest spring run since BAFF went online in 1991. Unusual weather conditions may be among the causes of the decline observed in steelhead return number since 1992. However, the marked reduction in return rate of several year classes that have been stocked since 1997 may be due to reasons other than poor flow on the Kewaunee River or low lake level.

Changes in average, standard and trophy weights may be due to a larger percentage of the run being younger (smaller) fish returning to the weir. Why older fish are absent from the return is unknown at this time and may be related to angler harvest, fish health, stocking location or predation on smolts.

Gamete collections for all three strains of steelhead were spotty from BAFF in 2003, but should not impact the total number of steelhead stocked in 2004 because of the contribution of gametes from the Root River Steelhead Facility.

Summer/fall runs of steelhead were also affected by weather. Although there was abundant late spring and summer rain, river flow did not increase enough to trigger steelhead runs into the river, making 2003 a very poor year for Skamania.

We will begin to evaluate the magnitude of the smolt out-migration from the Kewaunee River in 2004 and several years thereafter. We hope that results from this work will give some clues on the reasons for the decline in return number of steelhead to BAFF.

REFERENCES

Baumgartner, M. 1995. Operational plan for the C.D. “Buzz” Besadny weir. Wisconsin Department of Natural Resources. Unpublished report. 23 p.

Daly, R. 1968. Chasing Rainbows. Wisconsin Conservation Bulletin. July-August 1968. 2 p.

Hogler, S. and S. Surendonk. 1997. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 1992-1995. Wisconsin Department of Natural Resources. 52 p.

Hogler, S. and S. Surendonk. 1998. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 1997. Wisconsin Department of Natural Resources. 34 p.

Hogler, S. and S. Surendonk. 1999. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 1998. Wisconsin Department of Natural Resources. 25 p.

Hogler, S. and S. Surendonk. 2000. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 1999. Wisconsin Department of Natural Resources. 34 p.

Hogler, S. and S. Surendonk. 2001. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 2000. Wisconsin Department of Natural Resources. 34 p.

Hogler, S. and S. Surendonk. 2002. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 2001. Wisconsin Department of Natural Resources. 22 p.

Hogler, S. and S. Surendonk. 2003. Return, size, Age and Movement of Steelhead at the Besadny Anadromous Fisheries Facility, 2002. Wisconsin Department of Natural Resources. 21 p.

Kubisiak J. 2003. Wisconsin's 2002 open water sportfishing effort and harvest from Lake Michigan and Green Bay. Wisconsin Department of Natural Resources. 19 p.

Seelbach, P. 1985. Smolting success of hatchery raised steelhead planted in a tributary of Northern Lake Michigan. Michigan Department of Natural Resources. Fish. Res. Rep. No. 1934. 23 p.

Wisconsin Department of Natural Resources. 1988. Lake Michigan Steelhead Plan. Administrative Report #29. Bureau of Fisheries Management. December, 1988. Madison, Wisconsin. 18 p.

Table 1. Summary of steelhead length and weight data collected during spring migratory runs at BAFF, on the Kewaunee River, 1996-2003.

Year	Strain	Number	Run %	Average Length (mm)	Length Range (mm)	Average Weight (kg)	Weight Range (kg)	Standard Weight (kg)*	Trophy Weight (kg)**
1996	Chambers	731	34.1	699	390-950	3.49	0.6-8.2	3.02	5.40
	Ganaraska	414	19.3	630	341-865	2.72	0.4-6.1	3.05	4.41
	Skamania	175	8.2	734	436-907	3.52	0.8-6.9	2.73	5.25
	Other	824	38.4	--	--	--	--	--	--
	Total	2,144							
1997	Chambers	610	29.2	721	471-915	3.60	1.1-7.3	2.76	5.74
	Ganaraska	364	17.4	657	365-812	2.82	0.5-7.4	2.86	4.92
	Skamania	288	13.8	757	420-934	3.77	0.7-6.6	2.59	5.57
	Other	829	39.6	--	--	--	--	--	--
	Total	2,091							
1998	Chambers	236	26.9	706	394-900	3.38	0.6-6.9	2.79	5.50
	Ganaraska	241	27.5	593	270-795	2.09	0.5-5.1	2.67	4.31
	Skamania	74	8.4	795	540-953	4.33	1.7-7.4	2.36	6.97
	Other	325	37.1	--	--	--	--	--	--
	Total	876							
1999	Chambers	220	30.1	683	386-890	3.25	0.7-7.0	2.96	5.51
	Ganaraska	237	32.4	633	269-815	2.76	0.3-6.2	3.03	5.01
	Skamania	23	3.1	759	571-903	3.73	1.9-5.7	2.64	5.27
	Other	252	34.4	--	--	--	--	--	--
	Total	732							
2000	Chambers	69	20.3	750	475-865	3.98	0.9-5.8	2.91	5.67
	Ganaraska	84	24.7	637	370-832	2.87	0.4-5.7	3.06	5.48
	Skamania	40	11.8	761	635-894	5.78	1.4-5.8	2.49	5.71
	Other	147	43.2	--	--	--	--	--	--
	Total	340							
2001	Chambers	66	16.0	650	549-809	2.61	1.4-4.8	2.74	4.49
	Ganaraska	136	33.0	621	421-830	2.31	0.6-5.3	2.77	4.65
	Skamania	2	0.4	756	711-800	4.30	3.7-4.8	--	--
	Other	209	50.6	--	--	--	--	--	--
	Total	413							
2002	Chambers	51	13.6	716	440-860	3.45	0.6-5.7	2.88	5.66
	Ganaraska	61	16.2	662	375-870	2.82	0.4-4.7	2.80	4.25
	Skamania	17	4.5	718	586-788	3.10	1.6-4.3	2.48	4.32
	Other	247	65.7	--	--	--	--	--	--
	Total	376							
2003	Chambers	81	21.8	617	425-800	2.20	0.8-4.5	2.62	4.05
	Ganaraska	68	18.3	556	360-732	1.83	0.6-3.9	2.71	3.70
	Skamania	16	4.3	741	572-842	3.43	1.9-4.8	2.60	4.80
	Other	206	55.5						
	Total	371							

* Standard weight is a prediction based on a 660.4-mm steelhead.
** Trophy weight is based on the 95 percentile of weighed steelhead.

Table 2. Daily totals during 2003 operations at BAFF, by strain of steelhead.

Spring Run Steelhead

Date	Chambers Creek	Ganaraska	Skamania	Other	Day Total
April 17	31	22	12	82	147
April 23	42	36	4	89	171
May 1	8	10	0	35	53
Total	81	68	16	206	371

Summer/Fall Run Steelhead

Date of Operation	Chambers Creek	Ganaraska	Skamania	Other	Day Total
October 14					0
October 23					0
October 28					0
November 6					0
November 13					0
Total	0	0	0	0	0

Table 3. Average length, weight and run number by strain, clip, and sex during the spring spawning run at BAFF, 2003.

	Male			Female		
Strain and Clip	**Average Length (mm)**	**Average Weight (kg)**	**Run Number**	**Average Length (mm)**	**Average Weight (kg)**	**Run Number**
Chambers Creek						
Left Maxillary, Left Ventral (LMLV)	-	-	0	683	3.22	5
Adipose, Left Maxillary (ALM)	616	2.07	49	613	2.25	17
Left Maxillary (LM)	484	1.19	6	772	4.02	4
Chambers Creek combined average	**602**	**1.97**		**651**	**2.71**	
Ganaraska						
Adipose, Left Ventral (ALV)	587	1.99	29	574	1.99	17
Adipose, Right Ventral (ARV)	436	0.92	17	713	3.32	5
Both Ventral (BV)	-	-	0	-	-	0
Ganaraska combined **average**	531	1.60		605	2.29	
Skamania						
Adipose, Right Maxillary (ARM)	612	1.88	1	-	-	0
Right Maxillary (RM)	807	4.07	5	723	3.30	9
Right Maxillary, Right Ventral (RMRV)	-	-	0	695	3.04	1
Skamania combined average	775	3.71		720	3.27	

Table 4. The age distribution, length, and weight of returning clipped steelhead by sex for the Kewaunee River spring 2003.

Chambers Creek

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	6	49	0	0	0	Measured	0	17	5	4	0
Average Length (mm)	484	616	-	-	-	Average Length (mm)	-	613	683	772	-
Range (mm)	425-582	525-705	-	-	-	Range	-	555-662	667-695	710-800	-
Weighed	6	49	0	0	0	Weighed	0	17	5	4	0
Average Weight (kg)	1.19	2.07	-	-	-	Average Weight (kg)	-	2.25	3.22	4.02	-
Range (kg)	0.78-1.96	1.22-3.04	-	-	-	Range (kg)	-	1.36-3.10	2.74-3.54	3.42-4.52	-

Ganaraska

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	16	29	0	1	0	Measured	0	17	0	5	0
Average Length (mm)	427	587	-	580	-	Average Length (mm)	-	574	-	713	-
Range (mm)	360-462	495-689	-	-	-	Range	-	545-620	-	690-732	-
Weighed	15	28	0	1	0	Weighed	0	17	0	5	0
Average Weight (kg)	0.82	1.99	-	2.36	-	Average Weight (kg)	-	1.99	-	332	-
Range (kg)	0.58-1.08	1.10-3.52	-	-	-	Range (kg)	-	1.56-2.92	-	2.78-3.86	-

Skamania

Age (Male)	2	3	4	5	6	Age (Female)	2	3	4	5	6
Measured	0	1	0	5	0	Measured	2	0	1	7	0
Average Length (mm)	-	612	-	807	-	Average Length (mm)	621	-	695	752	-
Range (mm)	-	-	-	760-842	-	Range	572-670	-	-	730-765	-
Weighed	0	1	0	5	0	Weighed	2	0	1	7	0
Average Weight (kg)	-	1.88	-	4.07	-	Average Weight (kg)	2.34	-	3.04	3.57	-
Range (kg)	-	-	-	3.64-4.76	-	Range (kg)	1.88-2.80	-	-	3.06-3.96	-

Table 5. Handling mortality by strain at BAFF during spring operations for the years 1994-2003.

Year	Strain	Number	Number Dead	Percent Mortality
1996	Chambers	731	41	5.6
	Ganaraska	414	7	1.7
	Skamania	175	3	1.7
	Other	824	7	0.9
	Total	**2,144**	**58**	**2.7**
1997	Chambers	610	4	0.6
	Ganaraska	364	7	1.8
	Skamania	288	0	0.0
	Other	829	5	0.6
	Total	**2,091**	**16**	**0.7**
1998	Chambers	236	5	2.1
	Ganaraska	241	1	0.4
	Skamania	74	0	0.0
	Other	325	4	1.2
	Total	**876**	**10**	**1.1**
1999	Chambers	220	1	0.5
	Ganaraska	237	1	0.4
	Skamania	23	0	0.0
	Other	252	0	0.0
	Total	**732**	**2**	**0.3**
2000	Chambers	69	0	0.0
	Ganaraska	84	0	0.0
	Skamania	40	0	0.0
	Other	147	0	0.0
	Total	**340**	**0**	**0.0**
2001	Chambers	66	1	1.5
	Ganaraska	136	1	0.7
	Skamania	2	0	0.0
	Other	209	0	0.0
	Total	**413**	**2**	**0.5**
2002	Chambers	51	3	5.9
	Ganaraska	61	3	4.9
	Skamania	17	0	0.0
	Other	247	3	1.2
	Total	**376**	**9**	**2.4**
2003	Chambers	81	0	0
	Ganaraska	68	0	0
	Skamania	16	0	0
	Other	206	0	0
	Total	**371**	**0**	**0**

Table 6. Steelhead fin clip patterns detected at BAFF during fall migrations, 1994-2003.

Strain and fin clip	1996	1997	1998	1999	2000	2001	2002	2003
Skamania								
Adipose, Right Maxillary (ARM)	97	57	8	8	3			
Right Maxillary (RM)	63	53	20	76	1	8	1	
Right Maxillary,Right Ventral (RMRV)				8	1			
Right Maxillary,Left Pectoral (RMLP)				1				
Right Pectoral, Left Ventral (RPLV)	1		2					
Left Maxillary, Left Ventral (LMLV)	2							
Total Skamania	163	110	30	93	5	8	1	0
Chambers Creek								
Left Maxillary (LM)	4	1		1				
Left Maxillary, Left Ventral (LMLV)	1							
Adipose, Left Maxillary (ALM)								
Total Chambers Creek	5	1		1				0
Ganaraska								
Adipose, Right Ventral (ARV)								
Adipose, Left Ventral (ALV)								
Both Ventral (BV)								
Total Ganaraska								0
Unknown								
No Clips	20	17	15	30	2	5	2	
Both Maxillary (LMRM)	1							
Adipose (?), Right Ventral (A?RV)	4							
Adipose (A)		1		1				
Other		2	1	20				
Total Unknown	25	20	16	51	2	5	2	0
Total Fall Steelhead Run	**193**	**131**	**46**	**145**	**7**	**13**	**3**	**0**

Table 7. Return rates (number per thousand stocked) for Chambers Creek steelhead during spring migrations on the Kewaunee River, 1996-2003.

	Year Stocked							
Return Year	1995	1996	1997	1998	1999	2000	2001	2002
1996	1.10	--	--	--	--	--	--	--
1997	5.49	0.00	--	--	--	--	--	--
1998	4.99	0.85	0.11	--	--	--	--	--
1999	0.48	5.26	0.80	0.03	--	--	--	--
2000	0.08	1.16	0.93	0.11	0.09	--	--	--
2001	0.00	0.18	0.11	0.09	1.51	0.00	--	--
2002	0.00	0.00	0.00	0.03	1.23	0.09	0.05	--
2003	0.00	0.00	0.00	0.00	0.11	0.15	1.79	0.17
Total	12.14	7.45	1.95	0.26	2.94	0.24	1.84	0.17

Table 8. Return rates (number per thousand stocked) for Ganaraska steelhead during spring migrations on the Kewaunee River, 1996-2003.

	Year Stocked							
Return Year	1995	1996	1997	1998	1999	2000	2001	2002
1996	0.94	--	--	--	--	--	--	--
1997	4.18	0.30	--	--	--	--	--	--
1998	2.67	3.57	0.35	--	--	--	--	--
1999	0.74	4.17	1.68	0.16	--	--	--	--
2000	0.14	0.57	0.57	0.58	0.51	--	--	--
2001	0.00	0.12	0.19	0.52	3.08	0.08	--	--
2002	0.00	0.00	0.00	0.16	0.13	0.08	0.16	--
2003	0.00	0.00	0.00	0.00	0.17	0.00	1.49	0.45
Total	8.67	8.73	2.79	1.42	3.89	0.16	1.65	0.45

Table 9. Return rates (number per thousand stocked) for Skamania steelhead during spring migrations on the Kewaunee River, 1996-2003.

	Year Stocked							
Return Year	1995	1996	1997	1998	1999	2000	2001	2002
1996	0.00	--	--	--	--	--	--	--
1997	0.03	0.03	--	--	--	--	--	--
1998	0.68	0.06	0.00	--	--	--	--	--
1999	0.37	0.30	0.00	0.00	--	--	--	--
2000	0.14	1.03	0.00	0.00	0.12	--	--	--
2001	0.00	0.00	0.00	0.02	0.03	0.00	--	--
2002	0.00	0.00	0.00	0.00	0.43	0.03	0.00	--
2003	0.00	0.00	0.00	0.00	0.32	0.03	0.03	0.05
Total	1.22	1.42	0.00	0.02	0.90	0.06	0.03	0.05